

Chapter 25

Fire

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Fire

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Fire

25.1 Introduction

The most common hazard that surrounds us, whether at work or at home, is the presence of combustible materials that can be ignited, leading to a fire. However, if proper control methods are applied, the risk of injury, illness, and property damage can be reduced to an acceptable level. To minimize the risk from fire, LLNL will maintain an improved risk level of fire protection by

- Designing facilities using fire-resistant materials or those of limited combustibility.
- Using building materials and components that have been tested and approved by a nationally recognized testing laboratory when applicable.
- Providing and maintaining adequate corridors, exits, and fire barriers (including door assemblies, dampers, and windows).
- Installing fire detection and suppression systems that can quickly react to the presence of fire.
- Controlling the presence and use of ignition sources and combustibles within each facility.
- Conducting routine fire inspections to identify fire hazards and areas that are not sufficiently protected.
- Conducting periodic inspections, tests, and maintenance of fire and life safety equipment and systems to ensure that they operate properly.

25.2 Overview of Regulations and LLNL Policies

The requirements and guidance provided in this chapter comply with (1) the National Fire Protection Association (NFPA) codes and standards, (2) Code of Federal Regulations, Title 29, Part 1910, Subparts E and L, and (3) DOE Order 5480.7A (Fire Protection). A detailed list of these codes and additional guidance on LLNL-prescribed environmental, safety, and health (ES&H) standards applicable to fire safety can be found in the *Fire Protection Program Manual* (UCRL-MA 116646) and *LLNL Fire Protection Engineering Standard #1.2* (LLNL Fire Protection Program Criteria). The LLNL Improved Risk Program can be found in the *LLNL Fire Protection Engineering Standard #1.3*. All three of these documents are available from the Fire Protection Engineering Technical Leader (ext. 2-5148). For guidance, construction criteria, and safety inspections, contact your area ES&H team.

25.3 Applicability

The requirements and guidance in this supplement apply to all LLNL work processes including those performed by subcontractors, guests, visitors, and construction or labor contractors.

25.4 Process for Compliance and Risk Reduction

25.4.1 Classes of Combustibles

In general, there are three classes of combustible material:

1. Ordinary solids: wood, paper, rags, and plastics.
2. Fluids: liquids and gaseous fuels. These are further divided into the following classifications:
 - *Class IA liquids* have flash points below 73°F (22.8°C) and boiling points below 100°F (37.8°C).
 - *Class IB liquids* have flash points below 73°F (22.8°C) and boiling points at or above 100°F (37.8°C).
 - *Class IC liquids* have flash points at or above 73°F (22.8°C) and below 100°F (37.8°C).
 - *Class II liquids* have flash points at or above 100°F (37.8°C) and below 140°F (60°C).
 - *Class III liquids* have flash points at or above 140°F (60°C).
3. Other: oxidizing chemicals, fast-reacting or explosive materials, and combustible metals. Undesirable reactions from these materials can be surprisingly fast and can easily cause secondary fires.

This chapter does not contain guidance on flammable gases. For information and guidance on flammable gases, refer to Chapter 21 of this Manual or contact your area ES&H team.

25.4.2 Safe Handling of Ordinary Solid Combustibles

To minimize the risk of fires involving ordinary solids, follow these precautions:

- Avoid excessive accumulations of waste.
- Keep the work area orderly to minimize fuel paths that facilitate the spread of fire.
- Keep combustibles away from ignition sources (e.g., hot plates, soldering irons, and other heat- or spark-producing devices).
- Use an ash tray when smoking cigarettes. Ensure that the contents of ash trays are extinguished and cold to the touch before emptying into a waste receptacle. LLNL policy does not allow smoking inside buildings.

- Obtain a permit from the Emergency Management Division (Fire Department) of the Hazards Control Department for hot-work operations (see Section 25.4.6).
- Plan work to minimize the storage of excess combustibles in operating areas.
- Keep soiled rags in an approved container with an automatically self-closing lid. Consult the environmental analyst for your area ES&H team regarding any additional environmental requirements for rags containing solvents or other hazardous materials.
- Frequently inspect and check the area to ensure that these precautions are followed.

25.4.3 Safe Handling of Liquid Combustibles

To minimize the risk of fire involving liquid combustibles, follow these precautions:

- Obtain a material safety data sheet (MSDS) from the supplier for any combustible or flammable liquid, or contact your ES&H team to obtain an MSDS.
- Store flammable and combustible liquids that are to be dispensed in safety cans. (See Table 25-1 for exceptions and maximum sizes of containers.)
- Store flammable and combustible liquid waste in approved containers when they are kept inside buildings. Specially designed safety cans for flammable liquid wastes are available (see Table 25-1). Label the container "For Flammable Liquid Waste Only." If necessary, contact the environmental analyst or hazardous waste management technician for additional labeling requirements. Never put corrosive materials in a flammable liquid waste container; to do so could result in a fire or explosion. Waste may be transferred to drums or other larger shipping containers that meet the Department of Transportation (DOT) requirements for storing such materials outside buildings.
- Use properly labeled containers.
- When using such liquids, ventilate the area to prevent buildup of ignitable vapor/air mixtures or inhalation of toxic vapors or gases.
- Carefully avoid ignition sources (e.g., hot material, flames, and sparking equipment) in the general vicinity of these liquids.
- Electrically interconnect (i.e., bond) equipment likely to produce a static spark.
- Limit the quantity of these materials in operating areas.

Table 25-1. Maximum size of containers for combustible and flammable liquids.^a

Container type ^b	Flammable liquids			Combustible liquids	
	Class IA	Class IB	Class IC	Class II	Class III
Glass	1 pt	1 qt	1 gal	1 gal	5 gal
Metals (other than DOT drums) or approved plastic	1 gal	5 gal	5 gal	5 gal	5 gal
Safety cans	2 gal	5 gal	5 gal	5 gal	5 gal
Metal drums (DOT specifications)	60 gal	60 gal	60 gal	60 gal	60 gal
Approved portable tanks	660 gal	660 gal	660 gal	660 gal	660 gal

^a See Section 25.4.1 of this chapter for definitions of liquid classes.

^b Container exemptions: medicines, beverages, foodstuffs, cosmetics, and other common consumer items when packaged according to commonly accepted practices.

The volatility and hazards of liquids are increased by heating. Thus, additional requirements may be necessary where flammable and combustible liquids are exposed to storage conditions, use conditions, or process operations where they are naturally or artificially heated to or above their flash points. These requirements include consideration for items such as ventilation, exposure to ignition sources, and electrical area classifications. Consult your ES&H team for further assistance.

Storage Cabinets

Flammable and combustible liquids, including wastes, in quantities greater than a one-day supply (maximum of 25 gal in safety cans, 10 gal in containers other than safety cans) must be stored in approved flammable liquid storage cabinets. Flammable and combustible liquids removed from flammable liquid storage cabinets should be returned to the cabinet when they are not in use.

These cabinets must meet the following requirements:

- Cabinets must be placed where they will not obstruct egress.
- Cabinets must be properly tied down to meet seismic requirements.
- If ventilation is required, cabinets must be vented outdoors in such a manner that they will not compromise their fire resistance. Consult your ES&H team industrial hygienist for ventilation requirements.

For assistance with procuring an appropriate storage cabinet, consult your ES&H team.

Safety Cans

Safety cans are constructed of stainless steel, Monel, or tin and come equipped with a flame arrestor and spring-loaded cap on both the filling and pouring spouts. The double-perforated metal surface of the flame-arrestor screen prevents flames from entering the container. Safety cans are available for both dispensing products and collecting waste. These cans have been tested

and listed by a nationally recognized testing laboratory and shall not be modified.

For assistance with procuring an appropriate safety can, consult your ES&H team.

Drums and Drum-Storage Areas

Follow the requirements below for drums and drum-storage areas:

- Store drums in the vertical position.
- Keep drum bungs closed when liquids are not being transferred into or out of drums.
- Shield drums from the sun.
- When transferring flammable liquids into drums, use an approved funnel with an installed flash arrestor.
- Allow a minimum distance of 25 ft between a drum storage area and a building. There is no minimum distance requirement when the drum storage area faces a blank masonry wall. For further guidance, contact your area ES&H team.
- Post a “No Smoking” sign in the area. (This sign is available from the health and safety technician for your area ES&H team.)
- Keep an emergency spill kit near the drum storage area. The kit consists of a garbage can, dust pan, whisk broom, and absorbing compound. The absorbing compound is available from Central Supply (Stock No. 7930-67325).
- Install a 20-lb, dry-chemical fire extinguisher no less than 10 ft or more than 50 ft from the storage area. Contact either the Fire Department (ext. 2-7595) or the ES&H team Fire Protection Engineer for assistance in acquiring fire extinguishers.
- Contact the environmental analyst for your area ES&H team regarding environmental requirements for drum storage.

Transportation

Contact Transportation (ext. 2-7489) for onsite transport of drums containing hazardous materials. For drums containing hazardous waste, contact the hazardous waste technician for your area ES&H team.

25.4.4 Safe Handling of Other Combustibles

Many other combustible materials (oxidizing chemicals, fast-reacting or explosive materials, and combustible metals) present special fire safety and extinguishing problems. The hazards and safe handling of many of these materials are covered in Chapter 21 and various supplements of this Manual. Consult your area ES&H team for specific safety procedures and guidance.

25.4.5 Refrigerator Storage

Commercially available, domestic refrigerators contain built-in ignition sources and shall not be used to store flammable liquids or explosive chemicals. Light bulbs, switches, temperature controls, standard plugs, motor-starting relays, thermal-overload devices, and heater strips (for frost control) are all ignition sources.

Anyone who needs a refrigerator to store flammable liquids or explosives should contact the area ES&H team about available refrigerators specifically designed and approved for such use. Refrigerators and freezers that have either been specifically designed or modified to store flammable and/or combustible liquids safely shall be labeled as such. Labels are available from your area ES&H team.

25.4.6 Permits for Welding, Burning, or Other Hazardous Operations

As part of the LLNL program to control fire hazards, welding, soldering, and other hot-work operations with a high fire potential require permits. To obtain permits and additional information, call the Emergency Dispatch Center (ext. 2-7595) at the Livermore site or the Fire Department (ext. 3-5201) at Site 300.

Operations requiring permits include the following:

- Cutting and welding (arc, oxyacetylene, and heliarc) outside an approved location.
- Soldering when using a torch outside an approved location.
- Roofing or road work using tar pots.
- Using open fires for any purpose.
- Spray-painting when using flammable paints outside an approved spray booth.
- Barbecuing.
- Leaving portable electric appliances unattended (see Section 25.4.7).
- Altering, maintaining, or modifying any system that contains or may contain explosives or flammable liquids or gases when using heat-producing, spark-producing, or impact tools (e.g., electric power tools and cartridge-actuated tools)

Permits must be posted in the work area until the work is completed. Approved locations for hot work are areas that have either been designed specifically for that purpose or areas that have been modified to accommodate these operations safely. These areas must be reviewed by the Hazards Control Department to ensure that the necessary safeguards (e.g., adequate ventilation, noncombustible construction, and proper gas distribution systems) have been installed. For further guidance, contact your area ES&H team.

25.4.7 Portable Electric Appliances

Portable appliances should be obtained from Central Supply because Laboratory specifications ensure that these items meet Underwriters Laboratories (UL) requirements and are safe to use under approved circumstances. When installing or operating portable electric appliances, always follow these precautions:

- Place noncombustible material under the appliance.
- Maintain a clearance of at least 12 in. between the appliance and any combustible material.
- Ensure that the appliance is properly grounded or double-insulated.
- Use only those appliances that have been listed or labeled by a nationally recognized testing agency (e.g., UL or Factory Mutual Research Corp.).
- Use a timer to control unattended equipment that operate during off-hours. These timers will automatically de-energize the appliance during off-hours and energize it no more than 30 min before personnel arrive in the area.
- Keep the area immediately around an appliance clean and free of combustibles.
- Do not use electric appliances near combustible or explosive vapors or dust.

25.4.8 Fire Protection Equipment

Fire-protection equipment in operating areas consists of both fixed and portable items to detect fires, alert personnel, and suppress and minimize the spread of fire. Fixed equipment includes detectors, alarms, fire doors, fire dampers, automatic sprinkler systems, and other automatic fire-suppression systems. Portable equipment consists of fire extinguishers, which are required and available in buildings, and any specialized equipment the fire-fighting team brings to the area.

Before installing any fire-protection equipment, consult your ES&H team. The team is responsible for ensuring that the equipment selected is appropriate, reliable, and compatible with other systems in use at LLNL.

Fire Detection and Alarm

Several types of fire-detection systems will detect fire and transmit an alarm to the emergency dispatcher for purposes of initiating emergency action. In high-hazard areas, fire detectors also alert the building occupants and, in some cases, activate an automatic extinguishing system.

Fixed Fire Suppression Systems

Fires can be suppressed using automatic sprinklers or flooding systems (carbon dioxide, Inergen, or Halon. NOTE: Because of their potential for

depleting atmospheric ozone, Halon systems will no longer be installed at LLNL.). Automatic sprinklers contain a heat-sensitive element in the sprinkler head that usually activates at 165°F (70°C), causing the sprinkler head to open and spray water over the fire. The action of the water flowing through the sprinkler line activates an alarm at the Emergency Dispatch Center.

Sprinkler heads can be damaged and their functions impaired through mechanical or thermal abuse or careless handling. To ensure that sprinkler systems operate properly, employees and supervisors shall observe the following guidance:

- Contact the Plant Engineering Pipe Shop (ext. 3-0467) to have protective cages installed over sprinkler heads wherever mechanical damage could be likely.
- Keep normal and maintenance-type heat sources (i.e., torches or soldering irons) away from sprinkler heads.
- Keep furniture, equipment, and other materials away from sprinkler heads so that they do not interfere with the water-spray pattern.
- Allow 18 in. of clearance below sprinkler heads. Materials located closer than 18 in. interfere with the sprinkler spray pattern.
- Provide at least 3 ft of clearance around sprinkler control valves to allow fire-safety personnel access to them.
- Do not paint sprinkler heads.
- Do not use sprinkler piping to support other objects such as hanging plants and wiring.
- Ask the ES&H team Fire Protection Engineer to review the sprinkler system when planning to modify a work space (permanent or temporary) and before installing large equipment items.

Gaseous fire-suppression systems, such as carbon dioxide, Inergen, or Halon, are used to control or extinguish fires in normally unoccupied spaces. These systems have unique properties and require specialized knowledge in their design and application. For information regarding the use of such systems, consult the ES&H team Fire Protection Engineer.

Fire Extinguishers

Fire extinguishers are manually operated, portable devices that will discharge an extinguishing agent when properly activated. They are designed as a method of controlling a fire during the time between discovery and arrival of the Fire Department. It is essential that personnel be familiar with the

location and type of extinguishers in their work area. Successful results depend on the following (in the order of preference):

1. Notification of the Fire Department immediately upon learning of a fire.
2. Knowledge and proper training in the use of fire extinguishers.
3. Choice of the proper extinguishing agent (see Table 25-2).
4. Proper size of extinguisher for the size of the fire.
5. Proper operation of the extinguisher before attacking the fire.

Fire extinguishers are required to be inspected monthly and serviced at least annually. The monthly inspection is a quick check intended to give reasonable assurance that the extinguisher is accessible, fully charged, and operable. The following shall be checked as a minimum:

- The extinguisher is located in the designated area.
- There are no obstructions to access or visibility.
- Operating instructions on the name plate are legible.
- Seals and tamper indicators are not broken or missing.
- The extinguisher is full (determine fullness by weighing or “hefting”).
- There is no obvious physical damage, corrosion, leakage, or clogged nozzles.
- The pressure-gage reading or indicator is in the operable range or position.

Table 25-2. Effective extinguishants for burning materials.

Class of fire	Characteristics of burning materials	Extinguisher
Class A	Ordinary combustible materials such as cellulose products, wood, paper, cloth, plastics, or rubber	Water, multipurpose dry chemical (ABC), or Halon
Class B	Flammable and combustible liquids such as oils, gasoline, alcohol, and solvents (see SAFETY NOTE 1 below)	Carbon dioxide, Halon, or dry chemical (BC or ABC) (see SAFETY NOTE 1 below)
Class C	Electrical equipment and wire installation while electrical current is on (see SAFETY NOTE 2 below)	Carbon dioxide, Halon, or dry chemical (BC or ABC) (see SAFETY NOTE 2 below)
Class D	Burning magnesium, thorium, uranium, potassium, and sodium metals	G-1 power (special graphite) or Metl-X (sodium chloride)

SAFETY NOTE 1: Do not use water on a flammable or combustible liquid fire because it will spread and accelerate the fire. An explosion may result if water is used.

SAFETY NOTE 2: Do not use water on energized electrical equipment. Many electrical fires can be controlled by safely turning off the power for equipment such as personal computers and photocopiers.

The Emergency Management Division performs this monthly inspection using a checklist incorporating the items previously mentioned.

Annual maintenance is a thorough examination of fire extinguishers that is performed by a qualified fire extinguisher service technician assigned to the Emergency Management Division of the Hazards Control Department. It includes an examination and any necessary repair or replacement, and is intended to give maximum assurance that extinguishers will operate effectively and safely. As part of an effective self-assessment plan (see Supplement 2.04 of this Manual), facility management should verify that the inspections noted and service are performed. Contact the Fire Department (ext. 2-7595) or the ES&H team Fire Protection Engineer for assistance in acquiring fire extinguishers.

Employees are urged to enroll in a one-hour, fire-extinguisher training class (course HS1670; see the *LLNL Course Catalog*) conducted by the Emergency Management Division of the Hazards Control Department. *It is unsafe for personnel who have not taken this course to use a fire extinguisher to control a fire.* Personnel who have not been trained in the use of fire extinguishers must not attempt to use them.

Fire Barriers

Fire barriers such as fire doors and windows, fire dampers, and fire walls are placed in strategic locations to block the spread of smoke and fire. The following requirements shall be observed:

- Fire doors must never be blocked or wedged open.
- Fire doors must be allowed to operate freely without obstructions.
- Fire doors and their frames contain labels from testing laboratories; these labels must never be removed or painted over.
- All penetrations made to walls and floors to accommodate piping, electrical conduit, wiring, or ducts must be properly sealed with approved fire-stopping material.
- Ceiling tiles removed to accommodate maintenance or construction activities must be replaced at the completion of the job or whenever work on the project is significantly delayed (i.e., for two weeks or longer).

Fire Hydrants

Fire hydrants are primarily used by the Emergency Management Division in emergency situations. But certain temporary activities (e.g., connections by gardeners and construction subcontractors) may be authorized by the Fire Chief. In such cases, call the Fire Department (ext. 2-7595) for authorization and observe the following guidance:

- Use only the valved outlets provided by the Plant Engineering Pipe Shop.

- Use only a hydrant spanner provided by the Pipe Shop; other types of wrenches can damage the flats on the valve stem.
- Do not leave connections unattended—connections to fire hydrants may remain only while attended. (This requirement does not apply to connections at construction sites.)
- Slowly open hydrant valves fully and then close one-eighth turn. This procedure is necessary to minimize the chance of damaging the valve if it is inadvertently turned and forced in the wrong position.
- When securing water, close the valve slowly.
- After using a hydrant, manually screw on the caps (hand-tight only).

25.4.9 Corridors and Exits

All Laboratory buildings are provided with egress systems (corridors, stairs, doors) to meet the requirements of NFPA Life Safety Code. This egress system provides building occupants with a safe way out of the building as well as the Fire Department with a way into buildings when responding to emergencies. To maintain the integrity of the egress system, the requirements below shall be observed.

Corridors

- When used as part of the egress system, corridors must have a minimum clear width of 44 in. in office buildings and 36 in. in laboratory buildings. In certain cases, corridors in existing laboratory or shop buildings may be permitted to have a clear width of 28 in. (check with the ES&H team Fire Protection Engineer).
- Corridors must always remain free of obstructions or impediments.

Exit Doors

- Exit doors and the routes to reach them must be properly identified and illuminated. Emergency lighting may also be required. Refer to Chapter 6 of this Manual for guidance on emergency lighting.
- No locks or fastening devices that will prevent free escape from the building are permitted.
- Doors must be openable by a single operation. Locks requiring multiple operations or special knowledge or effort to open are not permitted.
- The minimum door width shall not be less than 28 in. For new doors, contact your area ES&H team for requirements.
- Exit doors, including the floor area on both sides of the exit door, must be kept clear and accessible at all times.

When conflicts arise regarding security requirements and safe exiting requirements, contact the ES&H team leader for your area. The ES&H team leader can arrange for the proper parties to resolve the issue.

25.4.10 Construction Areas

Construction areas shall be maintained in a fire-safe condition. This includes maintaining egress paths and ensuring that the construction site is accessible to the Fire Department. The Fire Department (ext. 2-7595) should be consulted regarding specific access requirements for construction sites. Accumulations of combustible waste material, dust, and debris shall be removed from structures and their immediate vicinity at the end of each work shift or more frequently if necessary for safe operations.

Subcontractors must be made aware of the need for permits and portable fire extinguishers, provisions for the safe use of combustible materials, requirements for storing flammable and combustible liquids in approved safety containers, requirements for disposing excess construction materials, and LLNL's emergency telephone numbers. The LLNL representative who supervises the subcontractor is responsible for ensuring that this information is available to the subcontractor.

For facilities under construction, automatic sprinkler systems must be placed in service as soon as possible. The absence of a working detection or flow alarm system is not a reason to delay placing the sprinklers in service.

25.4.11 Fire Department Access

Proper access to all LLNL facilities is important to ensure a timely response to emergencies. Fire lanes have been established throughout the Laboratory to allow the Fire Department to gain access to buildings when responding to emergencies. These fire lanes are posted and must be kept clear at all times. No vehicles are allowed to park in these lanes under any circumstances. The Fire Department reviews all plans for building construction, trailer relocation, and fencing changes to ensure proper access. If you need assistance or have any questions about the Fire Department's vehicle access requirements or the adequacy of fire lanes, call ext. 2-7595.

25.4.12 Emergency Reporting

For emergency reporting purposes, at least one readily accessible analog telephone shall be located in all LLNL facilities. This telephone shall be in an area that is not subject to being locked (e.g., a lobby or hallway). For larger facilities, telephones shall be placed such that the travel distance to the nearest one is no more than 200 ft.

NOTE: The emergency dispatcher may request only brief information when you call. He/She will put you on hold to dispatch the Fire Department, then ask for more detailed information.

In an emergency,

- Call 911.
- Briefly state what happened and where it happened.

- Indicate if anyone was hurt and how badly.
- Give your name and the extension you are calling from; do not hang up unless the dispatcher tells you to.
- Wait in the area until the Fire Department arrives and to provide information to the Incident Commander.
- In large facilities, have someone meet the Fire Department personnel at the entrance to guide them to the scene

The emergency dispatcher may need the following additional information for specific types of emergencies:

- Fires
 - What is burning?
 - Is the fire small or large?
- Emergency Medical Assistance
 - Is the person conscious or unconscious?
 - How many people are injured?
- Hazardous Spills
 - The name of the material spilled, including the correct spelling if known.
 - Is it a liquid, solid, or gas?
 - Has anyone been exposed to the material?
 - Has the flow been stopped?

Also report any actions that may have or are being taken (e.g., attempts to extinguish the fire, whether the area has been evacuated, or whether CPR has been started). This information will help emergency response personnel anticipate actions that may be required upon arrival.

25.5 Responsibilities

Line management is responsible for maintaining a fire-safe working environment throughout all LLNL facilities. Individual supervisors are responsible for keeping their operating areas orderly and free of potential sources of ignition. Supervisors must ensure that employees understand and follow the guidance provided in this chapter. They should also notify their area ES&H team of any operational changes that alter the fire risk in their area so that protection can be adjusted accordingly. All employees must perform their work in a way that minimizes the possibility of starting a fire.

25.6 Training

OSHA regulations require that anyone who uses a fire extinguisher must be trained in its use. Course HS1670 fulfills this requirement.

25.7 LLNL Contacts

For further information or assistance in the areas below, contact the Emergency Management Division (Fire Department) at ext. 2-7595, L-388.

- Emergency reporting
- Fire department access
- Fire extinguishers (including fire extinguisher training course)
- Hot-work permits

For fire safety information or assistance in subjects not covered above, contact your area ES&H team or the Fire Protection Engineering Technical Leader at ext. 2-5148, L-388.

25.8 References/Supporting Standards

National Fire Codes and Standards, National Fire Protection Association, Quincy, MA (latest edition).

DOE Order 5480.7A, *Fire Protection*, February 17, 1993.

Fire Protection Program Manual, Lawrence Livermore National Laboratory, Livermore, CA, UCRL-MA 116646 (latest edition).

LLNL Fire Protection Engineering Standards, Hazards Control Department, Lawrence Livermore National Laboratory, Livermore, CA (latest edition).

Code of Federal Regulations, Title 29, Part 1910, *Labor*, Occupational Safety and Health Administration, U.S. Government Printing Office, Washington, DC.

Code of Federal Regulations, Title 29, Part 1926, *Construction Standard*, Occupational Safety and Health Administration, U.S. Government Printing Office, Washington, DC.